Lottia gigantea size structure and abundance differences within the Monterey Bay National Marine Sanctuary

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Abstract

Owl limpets (*Lottia* gigantea) are ecologically important grazers that live on exposed rocky intertidal coasts. They are impacted by human visitation and harvesting due to limited enforcement in coastal rocky intertidal areas. The objective of this study is to investigate size structure and abundance patterns of *Lottia gigantea* at locations with different levels of vulnerability to human visitation and human foraging along the central coast of California. Limpet surveys were conducted at six locations in the Monterey Bay National Marine Sanctuary (MBNMS), three with low access to and three with high access to visitors. The number of visitors and their behavior, either active (trampling, removing, or touching organisms) or passive (observing, not touching organisms) were recorded at each location. The results of this study demonstrate that there is a difference in owl limpet size distribution and abundance patterns between rocky intertidal communities that differ in their levels of visitor use. Human mediated reductions in population size may alter individual energetics and raise questions regarding the unintended effects of Marine Protected Areas (MPAs) on community level dynamics. Longer term, this study can also provide baseline data that may be used to assess the health of coastal marine ecosystems.

Methods

Limpet Surveys:

- Six study locations were chosen within the Monterey Bay National Marine Sanctuary (MBNMS) based on vulnerability to human visitation and harvesting
- Three with low vulnerability- Sea Lion Point, Carmel Point and Hopkins and three with high vulnerability-Sand Hill Cove, Point Piños, and Lover's Point (Figure 1).
- For each location, data were collected in ten 0.5 meter radius circular plots over a 15 meter permanent transect..
- In each plot *L. gigantea* were tagged, counted, and measured in length of sagittal plane (Figure 2), and their position relative to Mean Lower Low Water (MLLW) was recorded using a TopCon GTS 230-W Wireless Total Station.
- Digital images of grazing patches were taken and georeferenced in ArcMap using the total station data (Figure 3).
- Data will be collected once per month from July 2009 through July 2010.

Visitor Observations:

- The number of visitors and their behavior are recorded once to twice per month from June 2009 through June 2010,
- Behavior was classified as active (trampling, collecting) or passive (standing, kneeling, visually observing without turning rocks or removing organisms).

Figure 1: Map of study location near Monterey, California (red dots signify high vulnerability locations, blue dots signify low vulnerability locations) and a 15 meter photo transect at Sea Lion Point, which has been gereferenced in ArcMap using the georeferencing tool overlaying a DEM of distance from mean lower low water (MLLW).

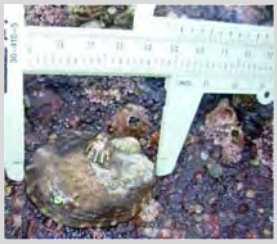

Figure 2: Photo of *L. gigantea* tag number 36 at Hopkins being measured with calipers, approximately 52 millimeters in length

Figure 3: Total Station with photo of *L. gigantea* grazing patch at Sea Lion Point. Center bolt of a plot is also shown.

Preliminary Results

The preliminary results suggest a significant difference in *L. gigantea* size (Kruskal-Wallis= p=4.90E-14, df= 1) (Figure 4) and abundance (Kruskal-Wallis= p<2.2E-16, df= 1) across sites that differ in their level of vulnerability (Figure 5).

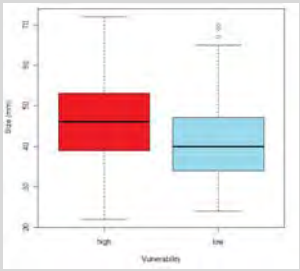

Figure 4: The size of limpets in millimeters measured at low and high vulnerability locations from July of 2009 to February of 2010.

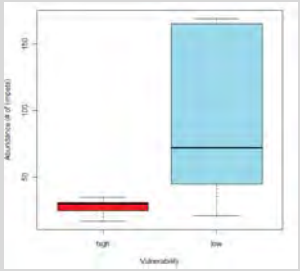

Figure 5: The abundance in number of limpets at low versus high vulnerability locations in July 2009 to February 2010.

The preliminary results of visitor observations from June 2009 to February 2010 indicate a significant difference in number of visitors between locations with high or low vulnerability (t-test p=1.02E-0.05, df= 19.48) (Figure 6), however there is not a significant difference in visitor behavior (both percent of passive visitors and percent of active visitors) and vulnerability (Passive t-test p=0.68, df=12.57, Active t-test p=0.20,, df= 23.37) (Figures 7 and 8).

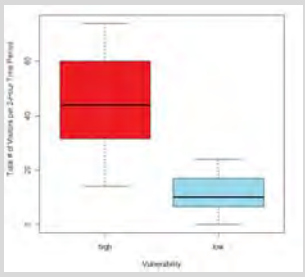

Figure 6: The number of visitors observed from June 2009 to February 2010 during 2 hour study periods.

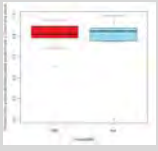

Figure 7: Percent of time visitors exhibited passive behavior during 2 hour study periods from June 2009 to February 2010.

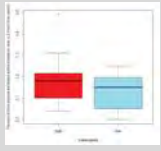

Figure 8: Percent of time visitors exhibited active behavior during 2 hour study periods from June 2009 to February 2010.

Discussion

- Based on the preliminary results, there is a difference between both size structure and abundance of *L. gigantea* and level of vulnerability of human impacts. *L. gigantea* were less abundant but larger in size in areas of high vulnerability and more abundant but smaller in size in areas of low vulnerability.
- These preliminary results are the opposite of findings in southern California, which have noted smaller sizes in high vulnerability areas, however this could be due to illegal harvesting in southern California (Sagarin et al. 2007).
- Human mediated shifts in population size may alter individual energetics as has been seen in other invertebrate populations (Robles et al. 2009).
- All study sites are within the Monterey Bay National Marine Sanctuary, more specifically MPAs. MPAs often seek to increase population abundance as well as individual size(Palumbi 2001). However, the preliminary results suggest otherwise.
- The results of this study may reveal unintended outcomes of MPAs on community level dynamics as seen in other species (Moreno et al. 1984; Pinnegar et al. 2000; Benedettie-Cecchi et al. 2003; Behrens and Lafferty 2004).
- This study could also be used as baseline data to assess changes in the rocky intertidal ecosystem as well as monitor human impacts.

The next steps:

- Analyze home range and grazing patches of *L. gigantea* from photo transects to link size and abundance to patch size (Figure 9).
- Measure invertebrate diversity within plots from photo transects to further link size and abundance with community dynamics.

Figure 9: Photo of *L. gigantea* within grazing patch at Carmel Point

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